Final Report

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Fluctuation in Lower Stem Nitrate Concentration in Small Grains

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Summary

Lower stem nitrate concentration is used as a guide for fertilization of small grains in Arizona. The objective of this study is to determine if the timing of stem sampling has an appreciable effect on stem nitrate and corresponding fertilizer recommendations. Durum and barley were grown at the Maricopa Agricultural Center and lower stems were analyzed for nitrate from 3-leaf to maturity. Stem nitrate concentration varied considerably between the 3-leaf and preboot stages, but thereafter was relatively constant and low (averaged 736 ppm). In this study, the timing of the stem sampling could have affected fertilizer recommendations before the pre-boot stage, but afterwards fluctuations in stem nitrate would have resulted in relatively minor differences in fertilizer recommendations.

Introduction

The lower stem nitrate concentration is used as a guide for fertilization for small grains in Arizona. In the 2002-2003 growing season, we developed guidelines for the use of the lower stem nitrate test at heading for achieving adequate grain protein concentration. Since these guidelines were released, questions about the fluctuation of lower stem nitrate between irrigations have arisen. The objective of this study is to document fluctuation in lower stem nitrate concentration during the season to answer the question of whether or not the timing of the stem sample is critical.

Procedures

Durum (Duraking) and barley (Baretta) were planted on December 1, 2004 at the Maricopa Agricultural Center on a sandy clay loam soil. The plots were 30 ft by 40 ft in size and replicated twice in blocks. Preplant fertilizer included 80 lbs N/acre and 100 lbs P_2O_5/acre as 16-20-0. Irrigations were applied on Dec. 1, Jan. 28, Mar. 4, Mar. 18, Apr. 1, Apr. 15, and Apr. 30. The seasonal rainfall was 7.35 inches, about twice normal. Most of this rain was recorded in January and February. Urea was broadcast and incorporated with irrigation water at a rate of 50 lbs N/acre on Jan. 28, 50 lbs N/acre on Mar. 4, and 50 lbs N/acre on Apr. 1 for a total N application of 230 lbs N/acre including preplant. The lower portion of the stem was sampled about twice per week from the 3-leaf stage until maturity. The portion of the lower stem between the seed and the soil surface was sampled until Feb 11, and after this date, the 2 inches of the stem above the soil surface was sampled. Heading occurred on Mar 16 (Baretta) and Mar 14 (Duraking) and maturity occurred on Apr 26 (Baretta) and May 3 (Duraking). The stem samples were oven dried, ground to pass through a 1mm screen, and analyzed for nitrate using ion chromatography. Differences between stem nitrate concentration of varieties were analysed using a completely randomized design.

Results and Discussion

The lower stem nitrate concentration was initially in the 4000 to 10,000 ppm range from the 3-leaf to 1-node stage, fell precipitously between the 1-node and preboot stages, and averaged 736 ppm from preboot until maturity (Fig. 1, Table 1). The sharp drop in stem nitrate concentration between the 1-node and preboot stages may be related to the rapid growth and nutrient uptake during this period. Irrigation and nitrogen fertilization at about the 6-leaf stage did not prevent this drop in stem nitrate. Nitrogen fertilizer application resulted in a slight increase in stem nitrate concentration in early and mid-March near the preboot stage, but a similar result was not obtained in early April between heading and milk. The stem nitrate concentration of the two crop kinds followed the same general pattern over the season, but stem nitrate of the durum was generally higher. The decrease in the stem nitrate in the month of February was sharp enough that timing of the tissue sample during this jointing stage would affect stem nitrate results and fertilizer recommendations. Fluctuations in stem nitrate after preboot were relatively minor and the timing of lower stem tissue sampling does not appear critical at this time.

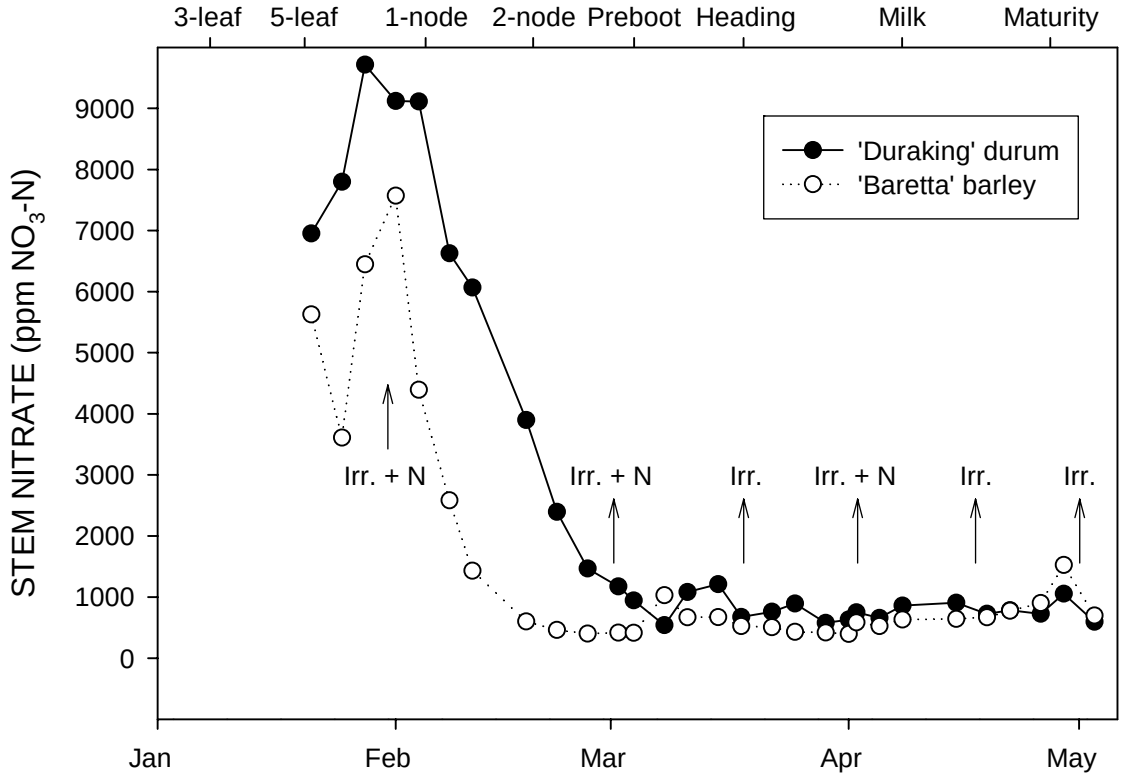

Fig. 1. Stem nitrate concentration of 'Duraking' durum and 'Baretta' barley during the season. "Irr" is an abbreviation for irrigation, "N" refers to 50 lbs N/acre on Jan. 28, 50 lbs N/acre on Mar. 4, and 50 lbs N/acre on Apr. 1, and "Ppt" is an abbreviation for precipitation or rainfall.

Table 1. Stem nitrate concentration of 'Duraking' durum and 'Baretta' barley during the season.

	Stem nitrate		
Date	Baretta	Duraking	Significant*
	ppm NO_3-N		
01/21/05	5626	6954	No
01/25/05	3610	7799	No
01/28/05	6447	9714	No
02/01/05	7569	9122	No
02/04/05	4391	9111	No
02/08/05	2583	6627	Yes
02/11/05	1433	6065	Yes
02/18/05	600	3898	No
02/22/05	462	2394	No
02/26/05	400	1466	No
03/02/05	417	1175	No
03/04/05	412	944	No
03/08/05	1029	539	No
03/11/05	669	1084	No
03/15/05	671	1213	No
03/18/05	524	673	Yes
03/22/05	504	760	No
03/25/05	428	894	No
03/29/05	420	576	No
04/01/05	394	630	No
04/02/05	584	749	No
04/05/05	522	660	Yes
04/08/05	629	860	No
04/15/05	643	907	No
04/19/05	669	724	No
04/22/05	776	784	No
04/26/05	901	726	No
04/29/05	1525	1054	No
05/03/05	696	595	No

* Significant refers to whether or not the stem nitrate concentration of the varieties are statistically different at the 10% probability level. The least significant difference (5% probability level) for comparing stem nitrate concentration at differing dates is 803 ppm.